A Compound Invertible Soft Jaw for a Machine Vise

Background of the Invention

Field of the Invention

[0001] This invention relates to vises used to secure a workpiece for fabrication of components and parts. More particularly, this invention relates to replaceable soft jaws within the vise into which a workpiece is set and secured for machining.

Description of Related Art

[0002] Machine vises are employed in many different machine tools such as milling machines, shapers and drill presses for providing a gripping surface to support and secure a workpiece to the machine. The machine vises commonly have a stationary receiving plate and a movable receiving plate mounted in opposition to each other. Jaws are replaceably mounted upon each of the receiving plates for gripping a workpiece, as the movable receiving plate with its jaw is shifted toward the fixed receiving plate with its jaw.

[0003] The jaws may be formed from hardened steel or alloy compositions in order to permit their continued use over long periods of time. However, the jaws are commonly formed from relatively soft metals such as aluminum or aluminum alloys. The soft jaws are commonly used where it

is desired to provide a particular gripping configuration on the face of the insert. For example, grooves or channels are commonly cut along the face or along one edge of the soft jaws in order to better adapt the soft jaws to a particular workpiece being secured by the vise.

[0004] A machinist generally cuts the grooves and channels cut into the soft jaws by first establishing an appropriate set of reference axes. From the reference axes, the operator then cuts the grooves and channels that effectively form a template. The soft jaws with the template formed therein is used to secure a workpiece during the machining, drilling, milling, cutting, and shaping to fabricate a finished item or part.

[0005] Upon completion of a run or fabrication of a requested lot of parts, it is common for the soft jaws with the template formed therein, to be removed from the machine vise for storage pending reuse. If another request for more parts is received the soft jaws are retrieved from storage and reattached to a machine vise. The machine vise used may not necessarily be the original vise used to fabricate the original parts. The machinist then attempts to align the soft jaws so as to establish the original reference axes. This is a difficult process requiring repeated trial and error to establish the reference axes and it is not uncommon to scrap of numerous parts. Often the machinist will become frustrated, reestablish the reference axes and re-cut the grooves and channels in the existing soft jaw until there can be no new template cuts made in the soft jaw. A

new soft jaw is then cut to establish the reference axis and the template, thus causing not only waste of the original soft jaws, but also waste of time and material in attempting to reuse the original templated soft jaws.

[0006] U.S. Patent 4,422,629 (Carlson) describes an accessory apparatus for vises that utilizes a pair of accessory members. One member has a Z-shaped cross-section and is secured to the stationary receiving plate of the vise. The other accessory member also has a Z-shaped cross-section that is secured to the moveable receiving plate of the vise. The accessory apparatus as described, provides three ranges of gripping areas. Two of the ranges are provided having zero radius gripping corners on the plates supporting the work clamped by the apparatus.

[0007] U.S. Patent 6,126,158 (Engibarov) illustrates a soft jaw for a machine vise. The jaw assembly is used on a slideway of a machine table includes one or more guide rods over which a vise jaw freely slides. No fasteners or mounting members are required to mount and demount the jaw from the assembly. Before the jaw is tightened to apply a clamping force, it is held in an unbiased condition without the need for biasing springs.

[0008] U.S. Patent 6,045,126 (Brzezinski) describes a vise jaw and a bolt to attach the vise jaw to the receiver plates of the vise.

[0009] U.S. Patent 5,193,792 (Di Marco) describes a soft jaw attachment system for a vise. The soft jaw attachment is prestressed to ensure tightness of the attachment of the soft jaw to the vice jaw.

[0010] U.S. Patent 4,602,772 (Wight, et al.) teaches a replaceable vise jaw insert assembly for mounting on either the fixed or movable vise jaw of a mill vise. The vise jaw insert assembly includes a clamping member. Facing surfaces of the clamping member and vise jaw are spaced apart and inclined relatively toward each other. An insert member having a wedge-shaped portion configured for generally mating engagement with the facing surfaces of the clamping member and vise jaw causes the wedge-shaped portion of the insert member to be captured between the clamping member and the vise jaw. The insert member is also formed with a gripping surface for securing a workpiece on the mill vise.

[0011] U.S. Patent 4,573,669 (Gerry) describes a machine vise having jaw plates carried by each jaw of the machine vise. The jaw plates provide a steady rest structure and effectively and efficiently reduce the set up time required to arrange numbers of like pieces of work in predetermined clamped relationship within and between the jaw plates.

Summary of the Invention

[0012] An object of this invention is to provide a compound soft jaw for use in a machine vise.

[0013] Another object of this invention is to provide a compound soft jaw for a machine vise where a template for a workpiece is formed in the compound soft jaw.

[0014] Further, another object of this invention is to provide a compound soft jaw for use in a machine vise where multiple templates for different workpieces may be formed within the compound soft jaw.

[0015] Still further, another object of this invention is to provide a compound soft jaw for use in a machine vise having a replaceable soft jaw member into which the templates of the workpieces are cut.

[0016] To accomplish at least one of these objects and other objects, a compound soft jaw includes a primary jaw member generally formed of steel and a first secondary jaw member generally formed of aluminum. The primary jaw member is secured to a receiving plate of the machine vice. The first secondary jaw member is secured to the primary jaw member. The first secondary jaw member is machined to have a cutting template formed therein such that as the workpiece is secured within the machine vise, the workpiece is machined according to the template. Upon completion of machining of the workpiece, the first secondary jaw member is replaceable by a second secondary jaw member into which a second cutting template is formed.

[0017] The primary jaw member has a height less than a height of the receiving plate. The secondary jaw member is placed on the primary jaw member and is forced into contact with a surface of the receiving plate onto which the primary jaw member is secured. The secondary jaw member as forced to the receiving plate is then supported by the receiving plate and prevents the secondary jaw member from movement during securing the workpiece within the machine vise.

[0018] Rather than replace the first secondary jaw member, the second secondary jaw member may in fact be the first secondary jaw member. The first secondary jaw member is removed from the primary jaw member, rotated or inverted, and re-secured to the primary jaw member, with a second cutting template formed therein.

[0019] The compound soft jaw has at least one fastener of a first type to secure the primary jaw member to the receiving plate. Preferably there are two of the first type fasteners with which to secure the primary jaw member to the receiving plate. The two first type fasteners secure the primary jaw member to the receiving plate with a torque of greater than approximately 250 in./lbs. and are ½ "X 13 cap screws. The cap screws are placed in openings formed in the primary jaw member so as to secure the primary jaw member fastener to the receiving plate.

[0020] The compound soft jaw further includes at least one of a second type fastener to secure the secondary jaw member to the primary jaw

member. Preferably there are three second type fasteners that secure the secondary jaw member to the primary jaw member. The three second type fasteners secure the secondary jaw member to the primary jaw member with a torque of greater than approximately 250 in./lbs. and are ¼" X 20 cap screws. The cap screws are placed in opening in the secondary jaw member to secure the secondary jaw member to the primary jaw member.

[0021] The primary jaw member, in addition to being formed of steel, may be formed of a material such as aluminum, brass, copper, plastic, wood, wood products. Similarly, the secondary jaw member, in addition to being formed of aluminum, may be formed of a material such as steel, brass, copper, plastic, wood, or wood products.

Brief Description of the Drawings

[0022] Fig. 1 is three-dimensional drawing of a compound soft jaw of this invention.

[0023] Figs. 2a – 2i are three-dimensional drawings showing the installation and use of the compound soft jaw of this invention in a machine vise.

[0024] Fig. 3 is a side plan view of the compound soft jaw of this invention.

Detailed Description of the Invention

[0025] In fabrication of a machined part, a machine operator secures jaw plates to the fixed and moveable receiving plates of a machine vise. The operator then establishes the reference axis for the machine tool relative to the vise and then, if required, cut a template into the jaw plates. A workpiece is secured within the jaw plates to the machine vise and the workpiece is machined to create the desired parts. At the completion of a run or group of parts, the jaw plates are removed from the receiving plates and stored.

[0026] If another run of parts is desired, the jaw plates are reattached to the receiving plates. The machinist must now correspond the reference axes of the jaw plates with the reference axes of the machine vise and with the machine tool. This requires an inordinate amount of time using dial indicators and often is not possible causing the machine operator to recut the existing jaw plates or "scrap" the jaw plates and fabricate a new set of jaw plates with a new template.

[0027] The inventor has observed that the majority of templated jaws have less than one third of the top surface of the soft jaw machined for the template. Further, the inventor observed that the generally less than one third of the depth from the top of the soft jaw is machined for the template. Very rarely were the soft jaws machined to a level encroaching on the hold down fasteners or screws for the jaw plates. Generally, the jaw plates are

constructed of a relatively soft material such as aluminum and if scrapped after a single use, these jaw plates become a relatively large expense.

[0028] The compound soft jaw plate of this invention allows a machine operator to quickly establish the reference axes of the machine tool and to provide an inexpensive method of providing a repeatable template to retain a workpiece for machining. Refer now to Fig. 1 for a description of the structure of the compound soft jaw **100** of this invention.

[0029] A primary jaw piece **10** is generally constructed of steel in the form a first rectangular solid. The first rectangular solid alternately may be formed of materials such as aluminum, brass, copper, plastic, solid wood, or composite wood products. The rectangular solid is then drilled and counter-bored to have the openings **12** that accept the two cap screw fasteners **15**. A secondary jaw piece **20** is constructed of a soft material such as aluminum in the form a second rectangular solid. The secondary jaw piece **20** alternately is formed of materials such as steel, brass, copper, plastic, solid wood, or composite wood products. The second rectangular solid is then drilled and counter-bored to form the openings **22** to accept the three cap screw fasteners **25**. The first rectangular solid is then drilled and tapped to have openings in alignment with the openings **22** to accept the second cap screw fasteners.

[0030] The dimensions of the compound soft jaw **100** of this invention are predicated generally on the style and size of the machine vise being used

to retain the workpiece. In the preferred embodiment the machine vise is an industry standard 6" machine vise (portions of which are shown in Fig. 1). The length **x** of the primary jaw piece **10** and the secondary jaw piece **20** is approximately the width or "X" dimension of the receiving plate **30** of the vise or approximately 6.00". The depth **y** of the primary jaw piece **10** and the secondary jaw piece **20** is determined by the size of the work piece and the template openings required to form the part, but is generally approximately 1.500" in depth or the "Y" dimension. The height z_1 of the primary jaw piece **10** must be less than the height or "Z" dimension of the receiving plate **30** and is generally approximately 1.375". The height z_2 of the secondary jaw piece **20** is determined by the dimensions of the workpiece and the depth of the template cuts required to be formed in the secondary jaw piece **20** for machining the final part. Generally the secondary jaw piece **20** has a height z_2 of approximately 0.625'.

[0031] The drilled and counter bored openings **12** in the primary jaw piece **10** are formed to align with drilled and tapped openings in the receiving plate **30**. The drilled and tapped openings in the receiving plate **30** are formed in the receiving plate at the time of the manufacture of the machine vise. Generally, the centerline of the drilled and counter bored openings **12** is at a distance d_7 of approximately 0.925" from the bottom of the primary jaw piece **12**. While the distance d_6 of the center line of the drilled and counter bored openings **12** from the top of the primary jaw piece **10** is not critical and is dependent on the height of the primary jaw piece **10**.

The dimension d_6 is approximately 0.450". The drilled and counter bored openings **12** in the primary jaw piece **10** are separated by a distance d_2 that is approximately 3.875". The distance d_8 from the end of the primary jaw piece **10** is approximately 1.0625".

[0032] The drilled and counter bored openings **22** in the secondary jaw piece and the openings in the primary jaw piece are placed such that the secondary jaw piece **20** can be rotated 180° or inverted to allow multiple surfaces to cut for templates of different parts or production runs of parts. The drilled and counter bored openings **22** are generally centered upon the top surface of the secondary jaw piece **20**. In the preferred embodiment, the centerline of the drilled and counter bored openings **22** is placed at a dimension d_5 that is approximately 0.750" from either side edge of the secondary jaw piece **20**. The drilled and counter bored openings **22** are separated by a dimension d_3 that is approximately 2.665". The center drilled and counter bored opening of the drilled and counter bored openings **22** is essentially centered on the secondary jaw piece **20**. The remaining two drilled and counter bored openings of the drilled and counter bored openings **22** are placed to avoid interference with the tapped and drilled openings **22** and the cap screw fasteners when they are placed in their openings **22**. Preferably, the openings of the drilled and counter bored openings **22** nearest the edges of the secondary jaw piece **20** are placed a distance d_4 from the edges. This distance (d_4) being approximately 0.335".

[0033] The cap screw fasteners **15** preferably are ½ X 13 socketed cap screws and the cap screw fasteners **25** are preferable ¼ X 20 socketed cap screws. Other fastener systems may be used to secure the primary jaw piece **10** to the receiver plate **30** and the secondary jaw piece **20** to the primary jaw piece **10** and still be in keeping with the intent of this invention.

[0034] The primary jaw piece **10** is secured to the receiving plate **30** by the cap screw fasteners **15**. Generally the cap screw fasteners **15** are secured tightly by receiving plate often using a level bar to multiply the torquing. However, this method secures the cap screw fasteners **15** with a torque of greater than approximately 250 in./lbs. The secondary jaw piece **20** is secured to the hard jaw plate **10** by the cap screw fasteners **25**. Similarly, the cap screw fasteners **25** are fastened using a lever bar and thus achieving a torque greater than approximately 250 in./lbs. During the torquing of the cap screw fasteners **15**, the secondary jaw piece **20** is forced to the receiving plate to insure that the secondary jaw piece is in full contact with the receiving plate **30**.

[0035] The secondary jaw piece **20** is then machined to provide the template for the workpiece. The template allows a machine tool to fashion the finished part. Upon completion of a production run for fashioning parts, a next part to be fabricated can be set up. The secondary jaw piece **20** is then removed and is either discarded or reversed and/or inverted.

The secondary jaw piece **20** is then reattached and then re-cut to form the template for the next part to be fabricated.

[0036] The secondary jaw piece **20** is sufficiently small such that it is relatively inexpensive. Replacing the secondary jaw piece **20** and cutting and re-cutting the templates in the soft jaws is much less costly than attempting to realign the reference axes of an existing pair of vise jaws as described.

[0037] Refer now to Figs. 2a–2i for a more detailed description of the method for forming and use the compound soft jaws of this invention. A machine vise has a base member **35** that is attached to a machine tool to secure a workpiece to the machine tool. A fixed receiving plate **32** is permanently affixed to the base member 35. The moveable receiving plate **34** is coupled to an adjustment mechanism **40**, which allows the moveable receiving plate **34** to advance to the fixed receiving plate **32**.

[0038] A first primary jaw piece **10a** is formed as described in Fig. 1 and secured by the cap screw fasteners **15a** to the fixed receiving plate **32**. The cap screw fasteners **15a** are secured with a torque of 250 in./lbs. A second primary jaw piece **10b** is formed as described in Fig. 1 and secured by the cap screw fasteners **15b** to the moveable receiving plate **34**. The cap screw fasteners **15b** are also secured with a torque of 250 in./lbs. A first secondary jaw piece **25a** and a second secondary jaw piece **25b** are formed as described in Fig. 1 and secured respectively to the

hard jaw plates **10a** and **10b** by the two sets of three cap screw fasteners **25a** and **25b**. The secondary jaw pieces are forced into firm contact with the fixed and moveable receiving plates, while the two sets of three cap screw fasteners **25a** and **25b** are secured with a torque of 250 in./lbs.

[0039] The moveable receiving plate **32** is advanced by the adjustment mechanism 40 until the opposing surfaces of the compound soft jaws **100a** and **100b** are in firm contact. A first template **50** is then cut into the top surfaces of the secondary jaw pieces **10a** and **10b**. The moveable receiving plate **32** is moved by the adjustment mechanism **40** to open the spacing between the compound soft jaws **100a** and **100b**. The workpiece **55** is placed and aligned within the templated compound soft jaws **100a** and **100b**. The moveable receiving plate **34** is again advanced by the adjustment mechanism **40** until the workpiece **55** is secured. The workpiece **55** is then machined by the machine tool to create a finished part.

[0040] Upon completion of the finished part, the cap screw fasteners **25a** and **25b** are extracted to free the secondary jaw pieces **20a** and **20b** from the primary jaw pieces **10a** and **10b**. The secondary jaw pieces **20a** and **20b** are then discarded and replaced by newly formed secondary jaw pieces **20a** and **20b** or the original secondary jaw pieces **20a** and **20b** are rotated 180° or inverted and re-secured to the primary jaw pieces **10a** and **10b** by the cap screw fasteners **25a** and **25b**.

[0041] While the original secondary jaw pieces **20a** and **20b** may inverted, generally the edge of the original secondary jaw pieces **20a** and **20b** are cut with the template. This often precludes the inversion of the original secondary jaw pieces **20a** and **20b** and cutting the bottom surface with a new template. However, the structure of the original secondary jaw pieces **20a** and **20b** is such that they maybe inverted for use of all edges of the original secondary jaw pieces **20a** and **20b**.

[0042] The moveable receiver plate **34** is advanced by the adjustment mechanism **40** until the opposing surfaces of the compound soft jaws **100a** and **100b** are firmly in contact. The secondary jaw pieces **20a** and **20b** are then cut with a second template **60** that determines a second part to fabricated. The moveable receiver plate **34** is moved to separate the compound soft jaws **100a** and **100b** to allow a second workpiece **65** to be placed and aligned within the compound soft jaws **100a** and **100b**. The moveable receiving plate **34** is advanced by the adjustment mechanism **40** to secure the workpiece **65** and the workpiece is machined according to the template **60**.

[0043] As can be seen, the first template **50** is now on the surfaces of the secondary jaw pieces **20a** and **20b** in contact with the fixed and moveable receiving plates **32** and **34**. The second template is on the surface of the secondary jaw pieces **20a** and **20b** that secure the workpiece **65**. The preferred embodiment, as shown, uses only the top surfaces of the

secondary jaw pieces **20a** and **20b**. A different choice of fastener to secure the secondary jaw pieces **20a** and **20b** to the primary jaw pieces **10a** and **10b** will allow the secondary jaw pieces **20a** and **20b** to be inverted.

[0044] To summarize the key points of this invention refer now to Fig. 3 The hard block piece **10** is formed with the drilled and tapped openings **12** and **22**. The openings **12** are placed to align with the openings **36** that are generally created during manufacturing of the receiver plate **30**. The openings **22** are placed symmetrically to allow the secondary jaw pieces to be rotated when preparing for a second fabrication run or to be even inverted.

[0045] The height z_1 of the primary jaw piece **10** must be less than the height of the receiver plate **30** by an amount $\mathbf{d_1}$. To prevent movement of the soft jaw plate **20**, the distance $\mathbf{d_1}$ is sufficient to allow the secondary jaw piece **20** to be in contact with and have support from the receiving plate **30**.

[0046] The secondary jaw piece **20** is formed with the openings **22** and secured by the cap screw fasteners **25** to the primary jaw piece **10**. The template **50** is cut into the secondary jaw piece **20** to determine the structure of the first part to be fabricated. After completion of the fabrication of the first part, the secondary jaw piece **20** is then removed, rotated, and re-secured to the primary jaw piece **10**. The surface **27** of the

secondary jaw piece **20** is then cut for the second template **60** of Fig 2h. The cutting of a new template with each new fabrication of a machined part allows accurate determination of the reference axis and accurate cutting of the template. This prevents waste and loss of time trying to re-establish a reference axis as in the jaw plates of the prior art.

[0047] While this invention has been particularly shown and described with reference to the preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made without departing from the spirit and scope of the invention.

[0048] The invention claimed is: